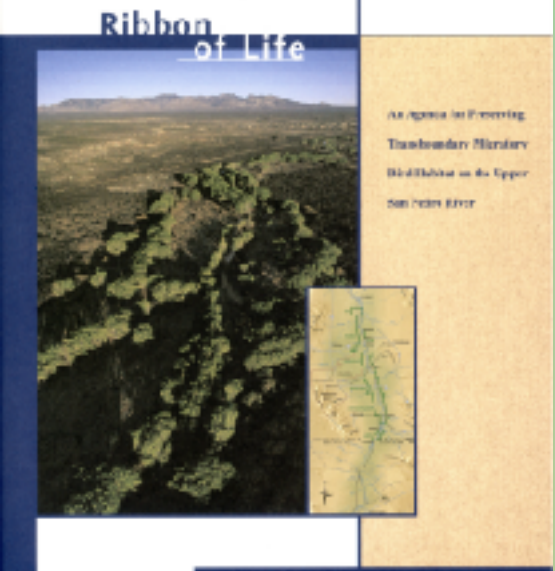


The San Pedro River Spatial Data Archive ...

A Database Browser for Community-based Environmental Protection



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Introduction

The assessment of land use and land cover is an extremely important activity for contemporary land management. A large body of current literature (Houghton et al. 1983, Turner 1990, McDonnell and Pickett 1993) suggests that human land-use management practices are the most important factor influencing ecosystem structure and functioning at local, regional, and global scales. The type, magnitude, and distribution of land use is a major factor affecting contemporary ecological and hydrological condition related to alteration of species composition, food-web structure, ecosystem carbon storage, and interactions between biota.

Landscape composition and pattern affect key ecological transfer processes which govern the movement or flow of energy, nutrients, water, and biota over time and operate at many scales (Forman and Godron 1986). A landscape framework provides the context 1) to investigate changes in composition, pattern distribution, and process function; 2) to compare conditions across mixed landscapes; and 3) to assess cumulative sources of environmental perturbation (Jensen and Everett 1994).

During the past decade, important advances in the integration of remote imagery, computer processing, and spatial analysis technologies have been applied to the study of distribution patterns of communities and ecosystems, ecological processes that affect these patterns, and changes in pattern and process over time. O'Neill et al. 1997 argue that a landscape approach is practical within current technologies for monitoring environmental quality over large regions and it may represent a less expensive approach than using traditional fine-scaled ground-based surveys. Although not all environmental perturbations can be explained or measured via alterations of land cover, this approach at least supplements existing technologies and improves our ability to measure and understand change and trend over time.

The San Pedro Data Browser was developed by the Landscape Ecology Branch of the U.S. Environmental Protection Agency (Las Vegas, NV). The goal of the Landscape Sciences Program is to improve decision-making relative to natural and human resource management through the development of an integrated system of landscape change detection metrics and models. The program has proceeded simultaneously along two lines, 1) a research component to develop and test landscape indicators and assessment protocols, and 2) an implementation component to demonstrate the application of landscape analysis protocols to ecological and hydrological assessments via a number of geographic initiatives.

Acquisition of primary data and database development is an initial feature of any landscape indicator and assessment project. The San Pedro Data Browser provides spatial data in user-friendly and accessible on-line and CD-ROM formats. This product provides for long term record keeping (archiving) and easy access to an exceptional assemblage of spatial biophysical data throughout the watershed. The motivation for distributing the geospatial data assembled for the San Pedro landscape analysis is to provide open access to the information for other researchers, natural resource managers, policy-makers, and public stakeholders.

The purpose of the San Pedro geographic initiative has been to measure land cover change and characterize relative vulnerability of natural resources in a semi-arid environment (Kepner et al. 2000). Vulnerability for the study location has been defined as loss of a desired state in which community-type diversity, productivity, and resistance to disturbance are maintained (CEC 1999a). It is the hypothesis of this project that landscape composition and pattern measures are diagnostic of environmental and hydrological condition and can be quantitatively measured using space-based technologies. Acquisition of primary data is the first step of the research process.

Abstract

It is currently possible to measure landscape change over large areas and determine trends in ecological and hydrological condition using advanced space-based technologies accompanied by geospatial data. Specifically, this process is being tested in a community-based watershed in southeast Arizona and northeast Sonora, Mexico using a system of landscape pattern measurements derived from satellite remote sensing, spatial statistics, process modeling, and geographic information systems technology. These technologies provide the basis for developing landscape composition and pattern indicators as sensitive measures of large-scale environmental change and thus may provide an effective and economical method for evaluating watershed condition related to disturbance from human and natural stresses. This project utilizes spatial data from a number of sources. The information has been modified to fit the community project area and

assembled into a database browser with search functionality. We have produced all spatial data into a one-stop, easy-access product that will be useful to all others who utilize geographic information systems and could benefit from the information in regard to research, natural resource management, human-use planning, and policy development. The San Pedro Data Browser is currently available on-line via the EPA server (<http://www.epa.gov/crdlweb/land-sci/san-pedro.htm>) and distributed as CD-ROMs. The purpose of the database is to disseminate available data that could be used by the stakeholder community to address environmental issues and improve environmental decision-making.

Key words: San Pedro River; community assessment; geographic information systems; landscape characterization; landscape ecology; remote sensing; geospatial data.

Methods

The study location originates in Sonora, Mexico and flows north into southeastern Arizona. The San Pedro River is an international basin with significantly different cross border legal and land use practices. The watershed embodies a variety of characteristics which make it an exceptional outdoor laboratory for addressing a large number of scientific questions in arid and semi-arid hydrology, ecology, meteorology, and the social and policy sciences. The Upper San Pedro Watershed represents a transition area between the Sonoran and Chihuahuan deserts and topography, climate, and vegetation vary substantially across the watershed. Elevation ranges from 900 - 2,900 m and annual rainfall ranges from 300 to 750 mm.

Biome types include desertscrub, grasslands, oak woodland-savannah, mesquite woodland, riparian forest, coniferous forest, and agriculture. The Upper San Pedro watershed encompasses an area of approximately 7,600 km² (5,800 km² in Arizona and 1,800 km² in Sonora, Mexico). All geospatial coverages have been organized to the watershed boundary and are referenced from its source near Cananea, Sonora to a pour-point associated with the U.S. Geological Survey gaging station located near Redington, Arizona.

The spatial coverages and the supporting information (metadata) have been organized relative to their geographical availability and partitioned into three data sets corresponding to either the entire watershed, Arizona portion only, or the Sonora portion only (refer to Screen 1). A variety of geographic themes have been developed and the coverages are available for download in ARC/INFO export format (refer to Screens 2 and 3). The information has been acquired from a number of sources and includes data generated within the EPA. The metadata comply with Federal Geospatial Data Committee standards and include important information relative to acquisition, location, processing level, file size, and format (refer to Screens 4 and 5).

The San Pedro Browser (EPA/600/C-00/002) is currently accessible on-line at the EPA website (<http://www.epa.gov/crdlweb/land-sci/san-pedro.htm>) and will be available from the ESA Ecological Archives data repository. Additionally, a limited number of CD-ROM copies were produced and distributed. In regard to system requirements, the San Pedro Browser CD-ROM will run on Microsoft Windows 95, 98, and NT operating systems with internet browser software that supports frames. This includes both Microsoft Internet Explorer Version 3 and above and Netscape Navigator Version 3 and above. Current versions of both internet browsers can be downloaded on-line at www.microsoft.com/msdownload/iebuild/msnie5/en/msn.asp and http://home.netscape.com/download/sd_nb32e408en.html, respectively. The San Pedro Data Browser contains links to other websites that require internet connection services to access the links. For best viewing of the San Pedro Data Browser the Windows desktop viewing area should be set to 1024 by 768 pixels or higher; some 15-inch monitors may require adjustments to the desktop viewing area.

Conclusions

Many communities do not have adequate information to understand and effectively plan improvements in their local environments. Information on environmental risks is most often delivered to communities as separate unrelated pieces. Without a more comprehensive and integrated view, communities will not be able to begin to address cumulative risk issues or set informed priorities for actions to improve their environments. The San Pedro River project has presented a number of effective examples, e.g. websites, bilingual fact sheets, and posters, for communicating science information to the public. Among the suggestions, the provision to develop an on-line and CD-ROM watershed database for all community members "to unite and organize available data for the public and experts" was strongly recommended by members of the local and international stakeholder community (CEC 1999b). This product provides easy public access to a comprehensive, long-term database which can be used by the community stakeholders to help understand their environment, set priorities, and make decisions for improvement. The database can be easily updated to include new coverages as they become available and could be used as a prototype science communication tool for other community assessment initiatives.

Acknowledgments

The geospatial data contained within the San Pedro Data Browser have been acquired from a number of sources including the Arizona State Land Department (Arizona Land Resource Information System), Instituto del Medio Ambiente y el Desarrollo Sustentable del Estado de Sonora (IMADES), U.S. Department of the Interior (e.g. U.S. Bureau of Land Management and U.S. Geological Survey), U.S. Environmental Protection Agency, and others. We thank those agencies who readily made data available to us, encouraged our efforts, and reviewed our interim products. Users are advised that verification of the quality of and use of any data supplied via this product are the responsibility of the user.

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See <http://www.epa.gov/crdlweb/land-sci/san-pedro.htm> for more information.